Investigating differences in Brexit-vote among Local Authorities in the UK: An ecological study on migration- and economy-related issues

Abstract

During a non-binding referendum on the UK's membership in the EU in June 2016, 51.9% of UK voters voted in favour of leaving the EU, also known as Brexit. However, the Local Authorities in the UK showed a wide variation in the referendum outcome. For 380 Local Authorities, the EU referendum outcome was linked to data derived from the 2011 Census, creating a database to investigate associations between local factors and the referendum outcome. This ecological study formulated and tested hypotheses related to migration and economic issues as those two topics dominated the EU referendum campaign. The results of multivariable generalised linear model analyses showed that the percentage of migrants arrived between 2004-2011 in local areas was positively associated with the proportion of Leave-votes. This indicates that the relative number of recently arrived migrants might have been a key factor in voters' decision. Further research might focus on the origin of those migrants. Furthermore, in England the percentage of lower educated was positively associated with the proportion of Leave-votes. This indicates that England was divided along educational lines. Moreover, this study also found a positive association between the proportion of elderly with self-reported poorer general health and the proportion of Leave-votes. Although investigating local health outcomes was beyond the study's aim, this result indicates that health issues might be of importance in understanding local differences in EU referendum outcomes. These findings provide us with a better understanding of the underlying factors of the Brexit-vote and directions for future research.

Keywords

European Union, United Kingdom, referendum, Brexit, quantitative analysis, ecological study

Introduction

During the European Communities membership referendum in June 1975, 67.2% voted 'Yes' to the question whether the United Kingdom (UK) should stay in the European Community. In 1975 the UK had been a member for two years of the European Economic Community (EEC). In line with the outcome of the referendum, the UK continued to be a member of the EEC. The membership of the European Union (EU), which replaced and succeeded the European Community in 2009 which had replaced the EEC in 1993, was questioned again 41 years after the first referendum. David Cameron, the Conservative Prime Minister of the UK, had promised in January 2013 a referendum on whether the UK should remain a member of the EU when the Conservatives would win the elections in 2015. After they won, the EU Referendum Act 2015 allowed for the holding of a non-binding referendum in the UK and Gibraltar before the end of 2017 (Thompson 2016). On 23 June 2016 72.2% of the electorate voted, and a majority (51.9%) voted in favour of leaving the EU.[1] This outcome is also known as Brexit.

The referendum result, however, differed among the four countries in the UK. In Scotland and Northern Ireland, a minority voted to leave the EU, 38.0% and 44.2%, respectively. In Wales and England, a majority voted to leave the EU, 52.5% and 53.4%, respectively. In some Local Authorities within England and Wales, a very large majority, over 80%, voted to remain in the EU. By contrast in some other Local Authorities a far majority, over 70%, voted to leave the EU.[2] These voting results show a wide variation in local EU referendum outcomes. By comparing the outcomes among the Local Authorities in the UK, the aim is to explore the relationship between local factors and the EU referendum outcome in an ecological study – that is comparing groups rather than individuals. Since the referendum campaign focused mainly on migration- and economy-related issues, the research question is, how are economic and migration issues associated with voting to leave the EU? Studying this question could shed light on social cleavages within the UK and could inform us on underlying factors of the Brexit-vote.

Campaign themes and media coverage

The UK referendum on EU membership forced voters into a Remain or Leave debate. Hence, two campaigns emerged: the Leave campaign with the slogan 'Take Back Control' and the Remain campaign with the slogan 'Stronger In'. The Leave campaign positioned their arguments on long-standing themes such as immigration, loss of sovereignty, expense of EU membership, and a growing sense of a detached liberal intelligentsia that failed to understand the plight faced by the poorest in society (Berry 2016; Crines 2016). The Remain campaign highlighted the benefits of access to the single market, fiscal stability, the free movement of people and ideas, and the potential risk to the economy by withdrawing from the EU (Crines 2016).

The EU referendum debate was then built around two main themes, the Leave camp's politicisation of immigration and the Remain camp's economic argument about the risk of Brexit (Glencross 2016). The Remain camp's focus on economic risks and expert endorsement on the economy might have resulted in a feeling that they represented an elite (Levy, Aslan & Bironzo 2016). Furthermore, it is argued that the Remain camp was unable to build a positive case for Europe, such as social and cultural benefits of EU membership, while Labour and Conservatives were largely running separate campaigns (Berry 2016). While Labour leader Jeremy Corbyn stressed workers' rights at the end of the campaign, neither he nor David Cameron were able to imagine a wider case for the EU around other challenges such as climate change or the conflict in the Middle East (Hughes 2016). In Scotland, however, all the major political figures were united behind the Remain side (Higgins 2016).

The Leave campaign was formed by two groups: 'Vote Leave' and 'Grassroots Out/Leave.EU'. In that way, the Leave camp could reach different audiences, from parliamentary fundamentalists and nostalgic elderly to quasi racists as well as large sections of the discontented working poor by using a variety of messages (Berry 2016). Messages on immigration ranged from immigrants 'sponging' off the welfare state and 'bleeding' the National Health Service (NHS) dry to migrants being involved in

criminality (Berry 2016). UK Independence Party's (UKIP) 'Breaking point' poster controversy – picturing a queue of Syrian refugees at the Slovenian border – claiming that 'we must break free of the EU and take back control of our borders', was highlighted as a key moment in the EU referendum campaign (Moore 2016). Cameron's EU renegotiation resulting in an agreement in February 2016 – among others a phasing in of tax credits over four years for new EU migrants – was hardly something that mobilised the masses. For it was the number of new migrants, not their access to benefits, that exercised anti-EU voters. Hence Cameron's EU renegotiation result might have played into the Leave camp's hand by confirming the weakness of the government's position over immigration within the EU (Glencross 2016).

Media played an important role in getting messages across during the EU referendum campaign. It seems the Leave camp was better backed up by the media as Firmstone (2016) concluded that newspapers supporting Leave (*Sun, Daily Mail, Daily Express, Daily Telegraph, Sunday Times*) published editorials on the EU referendum on more days, dedicated more resources and employed more compelling narratives and metaphors than the newspapers supporting Remain (*Mirror, Guardian, Independent, Financial Times*). Deacon *et al.*'s (2016) study on media (TV and newspapers) coverage of the EU referendum campaigns concluded that three issues dominated: the economy, immigration, and the conduct of the campaign itself. The economy received considerably more attention than immigration in the beginning of the campaign though later immigration took over economic issues, and this may have given the Leave campaign valuable momentum.

Previously reported factors in understanding the Brexit-vote

This section gives an overview of previously reported factors in understanding the Brexit-vote. It's not aimed to give a complete overview but to address main issues published by journalists in the media, by research agencies in reports, and by scholars in academic journals; each of these sources has their own way of producing and presenting information.

Media

After the EU referendum, the media published the outcome and highlighted some explanations to understand the vote to leave the EU. The *British Broadcasting Corporation (BBC)* published the result in maps, showing in which voting area a higher proportion voted to leave the EU, and charts showing the differences in voting 'Leave' by age groups – age group 65+ showed highest proportion to vote 'Leave' – making use of polling findings, and graphs to show referendum results for 30 areas with most elderly people, fewest graduates, and most people identifying as English using 2011 Census data.[3] Other media such as *The Guardian* also presented maps. This newspaper showed separate figures for some 'key demographics' in each voting area, such as proportion with higher education, median annual income, median age of residents, and proportion of residents not born in the UK to show associations with the outcome, though the used source is not given. From those figures *The Guardian* concluded that 'the best predictor of a vote for Remain is the proportion of residents who have a degree'.[4] *The Telegraph* also showed maps and highlighted 12 regions, such as 'West-Midlands votes to Leave' while remarking 'Birmingham has high immigration from non-EU areas'. *The Independent* showed '7 graphs that explain how Brexit won'. One of the graphs showed that of Conservative voters about 58% voted to leave the EU and among Labour voters this was about 37%.

Post-referendum surveys

As NatCen's British Social Attitudes surveys showed a growing support over the past decades for leaving the EU peaking at around 30% in 2012,[5] pre-referendum surveys in 2016 showed a further increasing support for leaving the EU with a majority voting 'Leave' at the referendum day.[6] To get a better understanding of the EU referendum outcome, some research agencies conducted a post-referendum survey. YouGov conducted a survey on Election Day, predicting a small majority (around 52%) voting to remain in the EU; among respondents who said to have voted Remain, for around 40% of them the main argument was that they believed a better UK economy is within the EU, and for those who said to have voted Leave, for respectively around 45% and 26% of them the main

arguments were Britain's right to act independently and immigration.[7] BMG research concluded from their post-referendum survey that respondents who were unemployed or retired were most positive about the referendum outcome while there was also a substantial generational divide with younger generations expressing far more concern than baby boomers on the outcome.[8] A post-referendum survey conducted by Panelbase for the newly founded newspaper *The New European* showed that for most of the Remain-voters the economy was a key issue while for Leave-voters it was immigration. Furthermore, it found no evidence for regret – if another referendum was held soon, it would return to the same result.[9]

Scholarly articles

A few scholarly articles published early 2016 raised issues which could play a crucial role during the EU referendum campaign. Vasilopoulou (2016) explored British Euroscepticism by analysing British attitudes towards the EU and concluded that utilitarian concerns regarding the cost and benefit of European integration could have a strong influence on the vote choice but only when combined with pro- or anti-arguments on EU freedom of movement. Henderson *et al.* (2016) found that the English are more Eurosceptic than neighbouring countries and predicted that if the Remain camp fails to articulate a cultural case for EU membership the Leave camp might dominate the 'cultural' dimension of the debate by convincing voters that English national identity is inconsistent with membership of the EU. Furthermore, according to Qvortrup (2016) the Leave camp's chance to win a majority of votes in the EU referendum increases when turnout rates are higher as he found such an association from studying all 43 EU-related referendums since 1972.

After the referendum, some first scholarly reactions were published in editorials or forums to shed some light on the EU referendum outcome. In his editorial for *BMJ*, Dorling (2016) stated that the outcome of the EU referendum has been unfairly blamed on the working class in the north of England because of differences in turnout and population size; most people who voted to leave the EU lived in the south of England. Furthermore, among those who voted to leave the EU a majority

was middle class, making this class crucial to the result. In his editorial for *European Societies*, Lianos (2016) put forward that Eurosceptic middle-class conservatives and working-class nationalists constituted a majority of the Leave-vote, while also some left-wing voters outside London unexpectedly voted to leave the EU. In an anthropology forum on Brexit, Koch (Green *et al.* 2016) emphasised that in the most deprived areas people have been disillusioned with politics for decades. Different from other elections is that during the EU referendum many decided to vote as it was a vote 'to refuse government as such' and to get back 'local control'. Shore (Green *et al.* 2016) adds that the EU referendum exposed deep-seated tensions and pre-existing social cleavages in Britain.

In summary, the media focused mostly on socio-demographic voting patterns according to age, income, educational level, and national identity. The post-referendum surveys reported on opinions about economy and immigration in relation to Brexit. In scholarly articles, some other issues were highlighted such as the impact of the turnout rate and group size on the result, and also socio-demographic voting patterns according to deprivation and working- or middle-class. Most of these explanations, however, were ad hoc observations or conclusions drawn from maps, figures or frequency tables focussing on single factors. Following-up on Shore's remark (Green *et al.* 2016) that the EU referendum showed Britain's multiple split on economical and socio-demographic characteristics, this study will therefore conduct multiple regression analyses allowing to assess the independent effect of each factor, while controlling for confounding factors, testing hypotheses on migration and economic issues.

Hypotheses

The underlying mechanism this study uses to make inferences about local population characteristics and the vote to leave the EU is based on issue-voting (e.g., Denver & Hands 1990). Garry *et al.* (2005) investigated whether voters' attitudes to Europe, so-called issue-voting explanation, or voters'

attitudes to their national political parties and incumbent national government, so-called second-order election model explanation, were more decisive in referendums on EU treaties using evidence from the two Irish referendums on the Nice Treaty in 2001 and 2002, respectively. They concluded that voters' attitudes to Europe and the EU were of more importance and emphasised the importance of campaigning in EU referendums. This study will use the arguments expressed during the EU referendum campaign in 2016. The two main issues in the EU referendum campaign were migration and economy as described in the previous sections. In this section, hypotheses are formulated based on issues raised in the campaign on migration and economy. The focus is on arguments put forward by the Leave camp.

Migration

One of the Leave campaign's arguments is that by leaving the EU, Britain will get back its control over its borders and will then be able to better control immigration. Such an argument might be stronger received in areas with relatively more immigrants. The immigrant hypothesis is (1): local areas having relatively more recently arrived migrants will show a higher proportion of voters having voted 'Leave'. When it's rather about the assimilation of immigrants, one aspect might be the use of English language by immigrants as linguistic assimilation is an important indicator as well as a factor for in- or exclusion (Alba & Nee 2003: 72; Casey 2016: 94–8, 167–9). The English language hypothesis is (2): local areas where relatively more residents have English as their main language will show a lower proportion of voters having voted 'Leave'. If it is not just about immigrant numbers but specifically about national identity[10], it might be better to identify areas where relatively more residents hold an English, Welsh, Scottish and/or UK/British identity. In their study on the development of attitudes to Europe in England since 1975, Henderson *et al.* (2016) found a link between nationalism and Euroscepticism in England. The national identity hypothesis is (3): local areas where relatively more residents hold an English, Welsh, Scottish and/or UK, British identity will show a higher proportion of voters having voted 'Leave'.

Economy

Leaving the EU could be based on a hope for a better future or just to turn away from the contemporary financial or economic malaise combined with the sense of a detached liberal intelligentsia failing to understand the situation of the poorest (Berry 2016; Crines 2016; Levy, Aslan & Bironzo 2016). This could have been appealing to those at the lower rungs of society such as unemployed, employed in lower socio-economic status jobs, or lower-educated persons. The unemployment hypothesis is (4): local areas where relatively more residents are unemployed will show a higher proportion of voters having voted 'Leave'. The socio-economic classification hypothesis is (5): local areas where relatively more residents are employed in lower socio-economic status jobs will show a higher proportion of voters having voted 'Leave'. The educational level hypothesis is (6): local areas where relatively more residents are lower educated will show a higher proportion of voters having voted 'Leave'.

Other socio-demographic characteristics

This study included also other socio-demographic characteristics. As those socio-demographic characteristics might have an impact on their own on the EU referendum outcome, differences in those socio-demographic characteristics between Local Authorities might also influence the impact of the migration and economic factors. As we have seen in the section on previously reported factors in understanding the Brexit-vote, it has been stated that elderly (aged 65+) had voted more often 'Leave'. The proportion of elderly in an area might for example also be related to economic issues as relatively more elderly in an area might result in a lower percentage of residents with a university degree. As more men than women are active in the labour market, we might expect likewise a relation between the proportion of male residents in an area and economic issues such as employment or socio-economic job status. Some pointed at the relationship between health and voting outcome.[11] People with poorer health might be more likely to worry about NHS access, which was one of the Leave campaign's arguments. Those with poorer health might also be more often

unemployed while among elderly the proportion of those having poorer health might be higher than among adults younger than 65 years of age. Finally, the turnout rate is included in the analyses to adjust for potential differences in voting behaviour between Local Authorities.

Sources, data and method

When it comes to European elections it is argued that there is not one European election but many national ones whereby national circumstances are critical (Marsh 2002). Likewise, the EU referendum on UK's EU membership was held in four countries: England, Northern Ireland, Scotland, and Wales. Whereas the referendum showed a majority in the UK voted to leave the EU, at the country level this outcome differed; a majority in England and Wales voted to leave the EU, but in Northern Ireland and Scotland, a majority voted to remain in the EU. It could also be argued that the referendum was not a national referendum but many local ones. Both the results of the EU referendum for Local Authorities in the UK and data on their demographic and socio-economic characteristics are publically available. As proposed by Johnston, Jones and Manley[12] and shown by Tammes and Oude Nijhuis (2011) in their study on the Dutch rejection of the EU Constitutional Treaty in the 2005 referendum, this is an ideal opportunity to study the association between local characteristics and EU referendum outcomes using ecological data.

Data sources

Following Cummins *et al.* (2005), to collect local data one has to be aware of what data are available, their form, their spatial scale and the cost. The most obvious requirement of data for ecological studies is that data are spatially referenced. Information on the referendum outcome and local characteristics can be found for each Local Authority in the UK. The referendum outcomes are publically available for all Scottish, Welsh, and English Local Authorities, and Gibraltar and provided

by the electoral commission in an Excel file;[13] no results were given for the Northern Irish districts. Data on Local Authority characteristics are publically available and provided by Infuse in Excel files. Since Local Authorities are given unique codes, these codes allow data to be merged into one file.

The data used here are derived from the 2011 Census (Office for National Statistics *et al.* 2016), five years before the referendum.[14] Using this data source all data on local characteristics are collected at the same time (27 March 2011) and in the same way (household survey) though a few questions were asked differently in the Scottish survey. However, during the five-year period population numbers have changed, such as the number of immigrants. The growth in immigrant population might differ between local areas and subsequently affect the ranking of local areas regarding the proportion of immigrants. To investigate whether local areas changed in ranking, middle layer super output areas (MSOA)[15] are compared using data derived from the 2001 Census (Office for National Statistics *et al.* 2016) and the 2011 Census (Office for National Statistics 2011) on percentage of people born in the UK.[16] Spearman's rank correlation (r_s=0.919, N=7,040) shows a very high correlation between the ranking of MSOAs in 2001 and in 2011 regarding the percentage of people born in the UK. Likewise, the rankings according to the percentage of unemployed (r_s=is 0.899, N=7,009) and the percentage of people aged 65 or over (r_s= 0.833, N=7,037) were compared. These results indicate that the ranking of local areas in 2001 and in 2011 are very similar with regard to percentage of immigrants, unemployed, and elderly, and it is assumed that this is still the case in 2016. Furthermore, it can be argued that it might not be the current situation that made up a voter's opinion but experiences over the past years (life experience and feelings such as growing feeling of 'left behind'). Overall, data derived from the 2011 Census are therefore suitable for this study.

EU referendum data

EU referendum data provided by the electoral commission on their website include the electorate – the number of registered voters eligible to take part in this referendum, the number of voters, and the (valid) number of Leave- and Remain-votes.[17] Using these data, we could determine for each

Local Authority the percentage of Leave-votes without Gibraltar and Northern Ireland, on average 53.1% (Table 1).

Ecological data on migration and economic issues

Following Morgenstern (2008: 512), ecological measures can be classified into three types; aggregated measures: means or proportion of observations derived from individuals in each group, environmental measures: physical characteristics of a place, and global measures: attributes of groups, places, etc., for which there is no distinct analogue at the individual level such as population density. To test the formulated hypotheses our focus is on aggregated measures using the 2011 Census (Office for National Statistics *et al.* 2016).

Migration issues

To test the immigrant hypothesis, the study used the 2011 Census question on year of arrival in the UK to calculate the percentage of migrants arrived between 2004 and 2011 of the total population, on average 4.3% (Table 1). In 2004 Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovakia, and Slovenia, and in 2007 Bulgaria and Romania became an EU member. To test the English language hypothesis, this study used the 2011 Census question on main language to calculate the percentage whose main language was English and/or Welsh, on average 94.0% (Table 1).[18] To test the national identity hypothesis, the 2011 census question on self-determined assessment of one's national identity allowed us to calculate the percentage of residents whose national identity was English, Welsh, Scottish, Northern Irish, or British, on average 94.2%.

Economic issues

To test the unemployment rate hypothesis, this study used the 2011 Census joint distribution of age and a person's economic activity to determine the unemployment rate among those aged 16 to 74, on average 4.1% (Table 1). To test the socio-economic classification hypothesis, the study used the 2011 Census joint distribution of age and Socio-economic Classification (NS-SeC) to calculate the

percentage of residents aged 16 to 74 who had a routine, semi-routine, lower supervisory or lower technical occupation, on average 33.0% (Table 1). To test the educational level hypothesis, the study used the 2011 Census question on people's highest educational qualification to determine the percentage of residents 16 or over having an educational level not higher than level 2 out of 4 levels, including no qualification that is on average 52.8% (Table 1).[19]

Confounding factors

Following Morgenstern (2008: 523), to reduce ecologic bias it is best to include covariates for categories of their joint distribution within groups. Using the 2011 Census this study used data available on the joint distribution of self-reported general health (percentage poor health)[20] by age (aged 16–64, or 65+), gender by age (aged 16–64, or 65+), and self-reported general health (percentage poor health) by gender. Using EU referendum data provided by the electoral commission the turnout rate for each Local Authority was determined.

Table 1: Descriptive statistics of data used on 380 Local Authorities in England, Scotland, and Wales.

Variables	**Mean**	**Std. dev.**	**Min.**	**Max.**
Outcome				
Proportion of Leave-votes UK (England, Wales, Scotland)	0.531	0.104	0.214	0.755
Predictors				
Pct. migrants arrived between 2004–2011 of population	4.3	4.4	0.5	25.0
Pct. national identity E/W/S/NI or British	94.2	6.2	64.4	99.3
Pct. main language is English and/or Welsh	94.0	6.9	57.8	99.3
Pct. unemployed	4.1	1.2	2.0	8.0
Pct. having a (semi-) routine, a lower supervisory or a lower technical occupation	33.0	7.3	13.9	51.7
Pct. highest educational qualification is level 2 or lower	52.8	8.4	23.7	72.4
Confounding factors				
Turnout rate	63.1	5.6	40.2	71.8
Pct. poor health within age group 16–64	14.9	3.0	8.9	23.2
Pct. poor health within age group 65+	49.6	6.7	35.2	68.0
Pct. male within age group 16–64	49.3	3.0	25.3	55.0
Pct. male within age group 65+	44.4	1.1	40.2	47.3
Pct. poor health within males	17.5	3.1	10.8	26.2

The data derived from the 2011 Census is on the whole local populations. Ideally, one would like to include information on just those who voted rather than on everyone. This information is hard to

find for local levels. Although for example the British Electoral Study is a big individual survey, it is not designed to investigate socio-economic and demographic distributions of voters and non-voters in the local level such as Local Authorities, as nearly all respondents in the wave 9 survey had voted during the EU referendum, and many Local Authorities show too small number of respondents to investigate properly the socio-economic and demographic distribution of voters and non-voters. We do know, however, differences in turnout rate among Local Authorities. The turnout rate will be included in the analyses and therefore control for potential differences in voting behaviour among Local Authorities.

Statistical methods

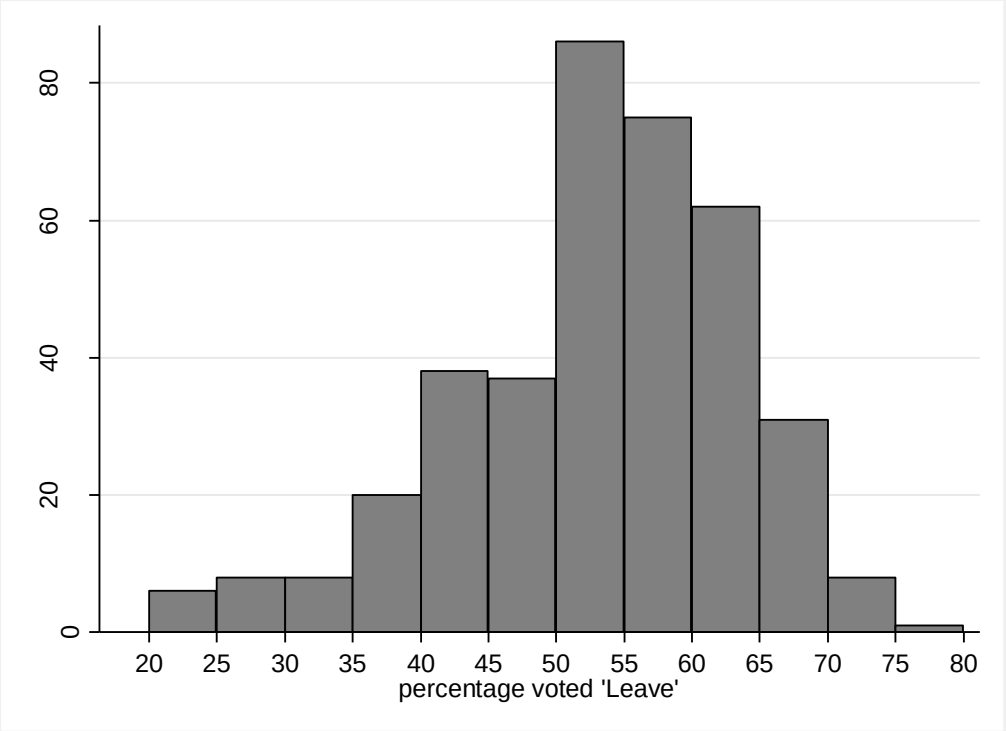
A research question such as what proportion of the voters voted to leave the EU is an example of a variable bounded between zero and one and takes the form of fractional response data (e.g., Gardeazabal 2010). Following Papke and Wooldridge (1996), this study used a generalised linear model (GLM) with a binomial distribution and a logit link function. In the multivariable analyses p-values and standard errors were adjusted for confounding factors and national residency by taking country as a cluster, taking into account the covariance between Local Authorities within a country. This allows us to examine more accurate associations between local factors and the proportion of Leave-votes than reports based on case studies, maps, frequencies and cross-tabulations. Following Frohlich *et al.* (2001), the analyses are not weighted by population (voters) size as the number of valid votes is not or only weakly correlated with the predictors and the outcome, and the study's aim is to test ecological associations. All analyses were undertaken in Stata/MP 14.1 (StataCorp, College Station, Texas, USA).

The EU referendum outcomes in the Local Authorities of England, Scotland and Wales

The EU referendum question was 'Should the United Kingdom remain a member of the European Union or leave the European Union?' and voters were asked to vote 'Remain a member of the European Union', or 'Leave the European Union'. Eligible to vote were (a) a British or Irish citizen living in the UK, (b) a Commonwealth citizen living in the UK who has leave to remain in the UK or who does not require leave to remain in the UK, or (c) a British citizen living overseas who has been registered to vote in the UK in the last 15 years. Those persons could vote at a polling station on 23 June between 7:00 a.m. to 10:00 p.m. by post after completing a postal vote application form and by proxy voting on a voter's behalf.[21]

On average, the Leave-vote carried 53.1% of all votes in 380 Local Authorities (Table 1). There were, however, substantial differences among those Local Authorities (see Figure 1). Support for 'Leave' was largest in Boston (75.6%). In 262 of the 380 Local Authorities the majority voted to 'Leave'; that is 68.9%. In 20 Local Authorities between 50% and 51% voted 'Leave' and showed thus a very small majority in favour of leaving the EU. The five Local Authorities with the smallest majority were Watford, Cherwell, East Hertfordshire, Birmingham, Reigate and Banstead. The lowest support for 'Leave', and thus the strongest for 'Remain', was in Lambeth where 21.4% voted 'Leave'. In 118 of 380 Local Authorities a majority voted 'Remain'; that is 31.1%. In eight Local Authorities between 49% and 50% voted 'Leave'; these Local Authorities showed thus a very small majority in favour of remaining a member of the EU: Bromley, East Hampshire, Harrogate, Leeds, Monmouthshire, Moray, Newcastle upon Tyne, and Vale of Glamorgan.

Figure 1: Percentage voting to leave European Union in 380 Local Authorities in England, Scotland, and Wales.



Comparing the Leave-vote among Local Authorities

In this section the observed differences in the proportion of Leave-votes among 380 Local Authorities are analysed through the use of a GLM. The results are presented in Table 2; a positive regression coefficient indicates a local factor is positively associated with the proportion of Leave-votes. Models 1a-1f in Table 2 presents the results of univariable analyses (crude or unadjusted associations). Those univariable analyses show that the percentage of residents whose national identity is English, Welsh, Scottish, Northern Irish, or British, the percentage of residents whose main language is English and/or Welsh, and the percentage of residents having a lower socio-economic job status are positively and significantly associated with the proportion of Leave-votes. For example, Local Authorities with an average percentage of residents reported their main language is English and/or Welsh (94%, Table 1) showed a mean proportion of Leave-votes (0.531).[22] An increase of 1% in residents whose main language is English and/or Welsh (from 94% to 95%) resulted in an increase of the proportion of Leave-votes to 0.537. The percentage of recently arrived migrants is inversely and significantly associated with proportion of Leave-votes. The percentage of lower-

educated and the percentage of unemployed do not show a significant association with the proportion of Leave-votes.

Model 2 in Table 2 shows the results of all migrant- and economy-related factors together with some confounding factors. This multivariable model shows that the percentage of recently arrived migrants, the percentage of residents reported an English, Welsh, Scottish, Northern Irish, or British identity, and the percentage of residents whose main language is English and/or Welsh are positively and significantly associated with the proportion of Leave-votes. As there were no significant non-linear effects found, these effects are not reported in Table 2. Furthermore, this model shows that the turnout rate is positively and significantly associated with the proportion of Leave-votes. Moreover, after dividing the other confounding factors into tertiles the results in model 2 show that a higher percentage of residents aged 16–64 with poorer health and higher percentage of elderly with poorer health are positively and significantly associated with the proportion of Leave-votes. Finally, a higher percentage of male residents is also positively and significantly associated with the proportion of Leave-votes. The results presented in model 2 support the immigrant and national identity hypotheses.

Table 2: Regression coefficients of univariable and multivariable generalised linear models of local migrant and economic factors on the proportion of Leave-votes, adjusted for clustering at country level, 380 Local Authorities in England, Scotland, and Wales.

	Models 1a-1f: univariable analyses			**Model 2: adjusted multivariable analysis**		
Factors	B-coef.	95% CI	P-value	B-coef.	95% CI	P-value
Pct. migrant arrived between 2004-2011	-0.045	-0.062; -0.027	<0.001	0.045	0.036; 0.055	<0.001
Pct. national identity E/W/S/NI or British	0.033	0.019; 0.047	<0.001	0.020	0.016; 0.025	<0.001
Pct. main language is English and/or Welsh	0.027	0.018; 0.036	<0.001	0.005	0.000; 0.009	0.049
Pct. unemployed	0.026	-0.023; 0.075	0.300	0.033	-0.023; 0.010	0.287
Pct. having a (semi-) routine, a lower supervisory or a lower technical occ.	0.036	0.013; 0.059	0.002	0.013	-0.010; 0.036	0.275
Pct. highest educational qualification is level 2 or lower	0.028	-0.018; 0.073	0.236	0.022	-0019; 0.062	0.296
Turnout rate				0.062	0.019; 0.104	0.004
1st tertile (lowest) pct. poor health within age group 16–64 (ref.)				Ref.		
2nd tertile pct. poor health within age group 16–64 (ref. tertile 1)				-0.020	-0.050; 0.100	0.188
3rd tertile pct. poor health within age group 16–64 (ref. tertile 1)				0.024	0.010; 0.037	0.001
1st tertile (lowest) pct. poor health within age group 65+ (ref.)				Ref.		
2nd tertile pct. poor health within age group 65+ (ref. tertile 1)				0.223	0.035; 0.102	<0.001
3rd tertile pct. poor health within age group 65+ (ref. tertile 1)				0.378	0.143; 0.611	0.002
1st tertile (lowest) pct. males within age group 16–64 (ref.)				Ref.		
2nd tertile pct. males within age group 16–64 (ref. tertile 1)				0.067	0.026; 0.107	0.001
3rd tertile pct. males within age group 16–64 (ref. tertile 1)				0.111	0.038; 0.186	0.003
1st tertile (lowest) pct. males within age group 65+ (ref.)				Ref.		
2nd tertile pct. males within age group 65+ (ref. tertile 1)				0.096	0.023; 0.169	0.010
3rd tertile pct. males within age group 65+ (ref. tertile 1)				0.036	-0.014; 0.086	0.162
1st tertile (lowest) poor health among males (ref.)				Ref.		
2nd tertile pct. poor health among males (ref. tertile 1)				0.096	-0.065; 0.113	0.257
3rd tertile pct. poor health among males (ref. tertile 1)				0.154	-0.064; 0.373	0.165
Constant				-9.042	-10.685;-7.400	<0.001

Ref.=reference category, B-coef.=B-coefficient, CI= confidence interval

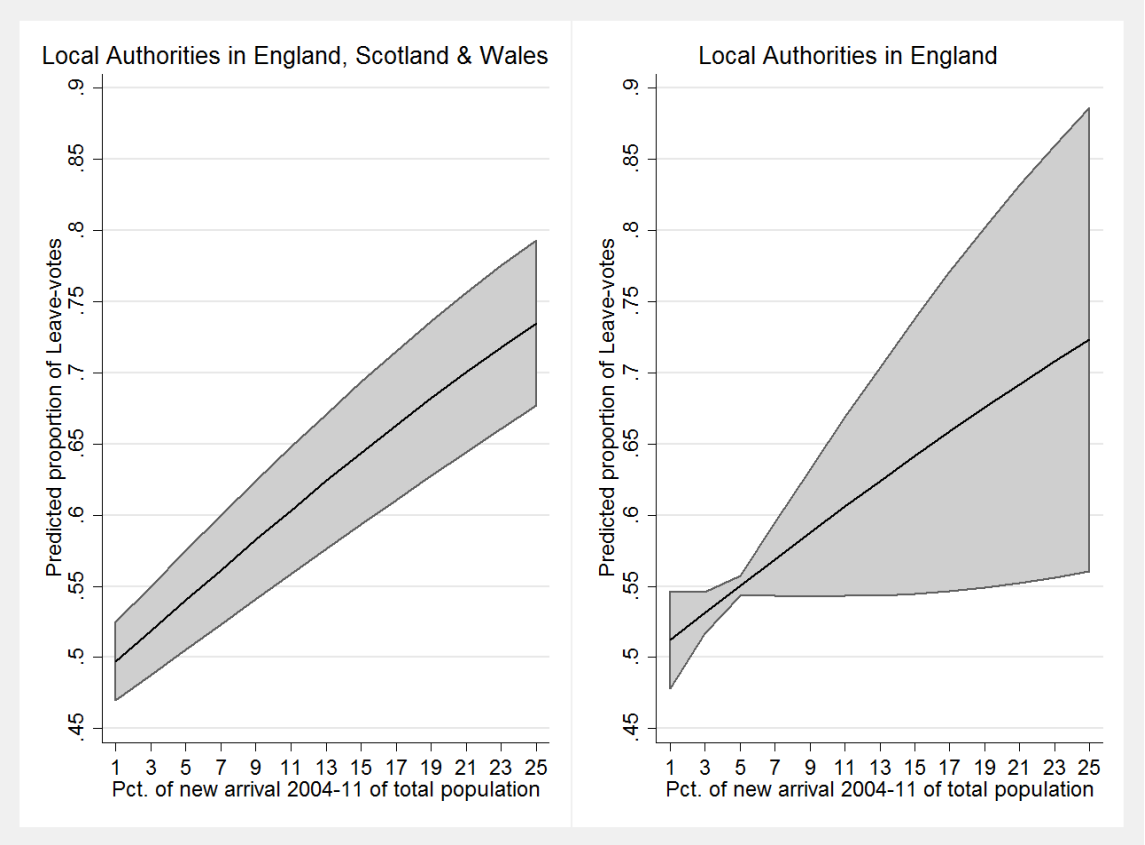
Table 3: Regression coefficients of univariable and multivariable generalised linear models of local migration and economic factors on the proportion of Leave-votes, 326 Local Authorities in England.

	Models 1a-1f: univariable analyses			**Model 2: adjusted multivariable analysis**		
Factors	B-coef.	95% CI	P-value	B-coef.	95% CI	P-value
Pct. migrant arrived between 2004–2011	-0.051	-0.062; -0.041	<0.001	0.040	-0.003; 0.084	0.070
Pct. national identity E/W/S/NI or British	0.038	0.031; 0.046	<0.001	0.022	-0.019; 0.064	0.288
Pct. main language is English and/or Welsh	0.031	0.023; 0.038	<0.001	-0.001	-0.013; 0.011	0.819
Pct. unemployed	0.043	0.001; 0.084	0.046	-0.052	-0.010; -0.005	0.032
Pct. having a (semi-) routine, a lower supervisory or a lower technical occ.	0.046	0.042; 0.050	<0.001	0.004	-0.003; 0.011	0.309
Pct. highest educational qualification is level 2 or lower	0.048	0.046; 0.052	<0.001	0.055	0.048; 0.061	<0.001
Turnout rate				0.010	-0.001; 0.021	0.062
1st tertile (lowest) pct. poor health within age group 16–64 (ref.)				Ref.		
2nd tertile pct. poor health within age group 16–64 (ref. tertile 1)				-0.020	-0.075; 0.036	0.486
3rd tertile pct. poor health within age group 16–64 (ref. tertile 1)				-0.041	-0.130; 0.048	0.363
1st tertile (lowest) pct. poor health within age group 65+ (ref.)				Ref.		
2nd tertile pct. poor health within age group 65+ (ref. tertile 1)				0.059	0.003; 0.116	0.040
3rd tertile pct. poor health within age group 65+ (ref. tertile 1)				0.058	-0.033; 0.148	0.211
1st tertile (lowest) pct. males within age group 16–64 (ref.)				Ref.		
2nd tertile pct. males within age group 16–64 (ref. tertile 1)				-0.001	-0.051; 0.050	0.977
3rd tertile pct. males within age group 16–64 (ref. tertile 1)				0.037	-0.012; 0.085	0.142
1st tertile (lowest) pct. males within age group 65+ (ref.)				Ref.		
2nd tertile pct. males within age group 65+ (ref. tertile 1)				0.039	-0.007; 0.084	0.094
3rd tertile pct. males within age group 65+ (ref. tertile 1)				0.005	-0.050; 0.060	0.863
1st tertile (lowest) poor health among males (ref.)				Ref.		
2nd tertile pct. poor health among males (ref. tertile 1)				-0.052	-0.117; 0.014	0.120
3rd tertile pct. poor health among males (ref. tertile 1)				-0.035	-0.125; 0.055	0.443
Constant				-5.467	-9.312; -1.621	0.005

Ref.=reference category, B-coef.=B-coefficient, CI= confidence interval

The results presented in Table 3 focus only on Local Authorities in England, where most of the voters lived and where a majority voted to leave the EU (54.5%, supplementary Table 1). Concentrating on model 2 in Table 3, there is weak evidence of a positive association between the percentage of recently arrived migrants and the proportion of Leave-votes. In Figure 2 the predicted linear effect of percentage of recently arrived migrants is shown separately for England, Scotland and Wales together and for England only, while the other predictors are taken at their mean values for the calculation, showing a steeper increase and a smaller 95% confidence interval for the England, Scotland and Wales model.

Figure 2: Predicted linear effect of percentage (95% confidence interval) of recently arrived migrants on proportion of Leave-votes.



Furthermore, in the England model the percentage of lower educated residents is positively and significantly associated with the proportion of Leave-votes, while the percentage of unemployed is (unexpectedly) inversely and significantly associated. As there were again no significant non-linear effects found, these effects are not reported in Table 3. Moreover, this England model shows a weak evidence of a positive association between turnout rate and the proportion of Leave-votes and some evidence of a positive association between the percentages of elderly with poorer health and the proportion of Leave-votes. Those results based on Local Authorities in England support the hypothesis on educational level, while they show some weak evidence supporting the immigrant hypothesis.

Since within the London Local Authorities only a minority voted to leave the EU (39.1%), the results of a model based on non–London English Local Authorities (Table 4, model 2) are compared to the results of the England model (Table 3, model 2). The results show a similar effect of percentage of lower-educated people on the proportion of Leave-votes. In Figure 3 the predicted linear effect of percentage of lower-educated people is shown separately for the all Local Authorities in England and for non–London English Local Authorities, while the other predictors are taken at their mean values for the calculation, showing a similar increase and a 95% confidence interval. Furthermore, within English Local Authorities outside London there are non-significant associations of the percentage of recently arrived migrants and the percentage of unemployed with the proportion of Leave-votes, while there is a stronger association found for the turnout rate and the percentage of elderly with poorer health. These results based on non–London English Local Authorities only support the educational level hypothesis. The absence of an association between the percentage of recently arrived migrants and the proportion of Leave-votes within English Local Authorities outside London might be due to the narrower range of the percentage of recently arrived migrants within English Local Authorities outside London (min.= 0.50%, max.=18.0%, supplementary Table 2) when compared to the 33 London Local Authorities (min.=3.1%, max.=25.0%) while within English Local Authorities outside London a majority voted to leave the EU (56.2%, supplementary Table 2).

Figure 3: Predicted linear effect of percentage (95% confidence interval) of lower-educated persons on the proportion of Leave-votes.

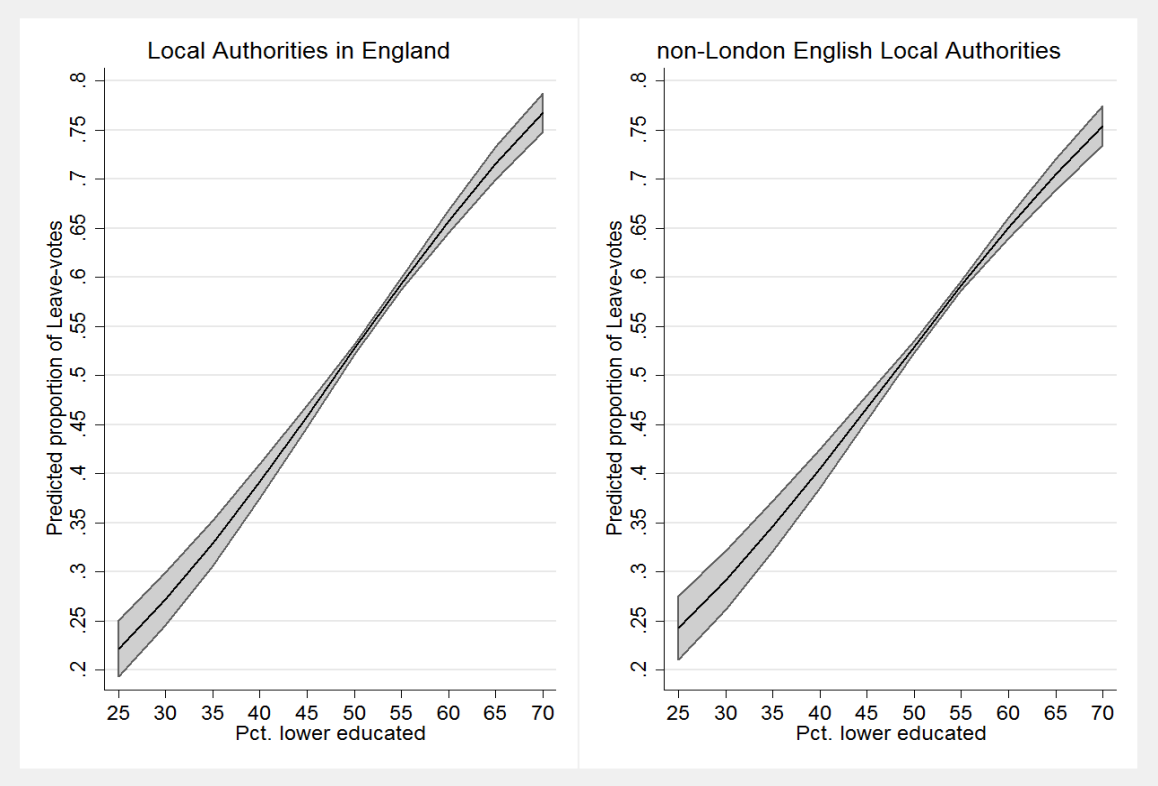


Table 4: Regression coefficients of univariable and multivariable generalised linear models of local migration and economic factors on the proportion of Leave-votes, 293 non–London Local Authorities in England.

	Models 1a-1f: univariable analyses			**Model 2: adjusted multivariable analysis**		
Factors	B-coef.	95% CI	P-value	B-coef.	95% CI	P-value
Pct. migrant arrived between 2004–2011	-0.033	-0.052; -0.014	0.001	0.015	-0.030; 0.060	0.521
Pct. national identity E/W/S/NI or British	0.028	0.014; 0.042	<0.001	0.004	-0.037; 0.044	0.855
Pct. main language is English and/or Welsh	0.017	0.006; 0.238	0.002	0.002	-0.011; 0.015	0.752
Pct. unemployed	0.120	0.089; 0.150	<0.001	-0.026	-0.070; -0.018	0.248
Pct. having a (semi-) routine, a lower supervisory or a lower technical occ.	0.039	0.035; 0.042	<0.001	0.005	-0.002; 0.012	0.153
Pct. highest educational qualification is level 2 or lower	0.046	0.042; 0.049	<0.001	0.050	0.044; 0.057	<0.001
Turnout rate				0.013	0.003; 0.023	0.013
1st tertile (lowest) pct. poor health within age group 16–64 (ref.)				Ref.		
2nd tertile pct. poor health within age group 16–64 (ref. tertile 1)				-0.011	-0.067; 0.044	0.690
3rd tertile pct. poor health within age group 16–64 (ref. tertile 1)				-0.075	-0.161; 0.010	0.083
1st tertile (lowest) pct. poor health within age group 65+ (ref.)				Ref.		
2nd tertile pct. poor health within age group 65+ (ref. tertile 1)				0.065	0.012; 0.118	0.016
3rd tertile pct. poor health within age group 65+ (ref. tertile 1)				0.108	0.023; 0.192	0.012
1st tertile (lowest) pct. males within age group 16–64 (ref.)				Ref.		
2nd tertile pct. males within age group 16–64 (ref. tertile 1)				0.010	-0.038; 0.0658	0.685
3rd tertile pct. males within age group 16–64 (ref. tertile 1)				0.046	-0.003; 0.095	0.066
1st tertile (lowest) pct. males within age group 65+ (ref.)				Ref.		
2nd tertile pct. males within age group 65+ (ref. tertile 1)				0.048	-0.002; 0.094	0.043
3rd tertile pct. males within age group 65+ (ref. tertile 1)				0.020	-0.032; 0.072	0.446
1st tertile (lowest) poor health among males (ref.)				Ref.		
2nd tertile pct. poor health among males (ref. tertile 1)				-0.049	-0.108; 0.010	0.105
3rd tertile pct. poor health among males (ref. tertile 1)				-0.029	-0.117; 0.058	0.509
Constant				-4.094	-7.941; -0.246	0.037

Ref.=reference category, B-coef.=B-coefficient, CI= confidence interval

Conclusions and discussion

A referendum is a unique national event for sociologists to study social cleavages and cohesion by examining the outcome across different groups or local areas. Though a majority of the voters in the UK voted to leave the EU during the UK's referendum on their EU membership, the outcome shows wide variation on both the country level and the Local Authority level. Since there are a few hundred Local Authorities in the UK, investigating referendum outcomes at the Local Authority level creates an opportunity to compare local referendum outcomes and to associate these outcomes with local characteristics such as migration- and economy-related issues. This study conducted multivariable GLM analyses for three different models: 1-Local Authorities in England, Scotland, and Wales, 2-Local Authorities in England, and 3-Local Authorities in England without London.

The percentage of recently arrived migrants showed a positive association with the proportion of Leave-votes, especially in the model with England, Scotland and Wales together. As this indicates that the relative number of recently arrived migrants in local areas might have been a key factor in voters' decision, further research might focus on the origin of those migrants in local areas since the UK already can control migration from non-EU countries. Furthermore, the positive associations of an English, Welsh, Scottish, Northern Irish, or British identity and English/Welsh language with the proportion of Leave-votes in the model with England, Scotland and Wales together might point to other factors such as nationalism. Whereas the underlying assumption of the formulated hypotheses in this study are based on the so-called issue-voting explanation (e.g., Denver & Hands 1990), it might be worthwhile in future research to also include (ecological) data, if available, on voters' attitudes towards their national political parties and incumbent national government.

Especially in the England models the percentage of lower-educated persons showed a positive association with the proportion of Leave-votes, while socio-economic status and unemployment rate showed respectively no association or an inconsistent association. This indicates that England was especially divided along educational lines, and further research might investigate underlying

perspectives and circumstances among the lower educated. Furthermore, other economic issues related to economic precariousness might be worthwhile to explore in future research, for example employment insecurity such as part-time or temporary employed, income insecurity such as earnings, and representation insecurity such as trade union membership and representation (e.g., Berrington, Tammes & Roberts 2014: 3; Standing 2011).

Future research might also focus on issues other than migration and economy. As it has been said that especially the elderly voted to leave the EU, this study showed that it might be those elderly with self-reported poorer general health. It could be worthwhile to explore issues related to local health outcomes as in the model with England, Scotland and Wales together shows also a positive association between the percentage of adults aged 16–64 with self-reported poorer health and the proportion of Leave-votes. Furthermore, some models show a positive association between the percentage of male residents and the proportion of Leave-votes, suggesting a gender issue which might be worth exploring further.

The measurements in the analyses were based on information over 2011, five years before the referendum, and on the whole population of the Local Authorities. Ideally, one would like to include information on just those who voted rather than on everyone. Although differences in distributions of voters according to background characteristics is unknown, this study included the local turnout rates to control for potential differences in voting behaviour among Local Authorities. Local Authorities have not changed much in ranking between 2001 and 2011 according to unemployment rate, percentage of UK-born, and percentage of elderly. Assuming little change in ranking between 2011 and 2016, the five-year gap between the Census data and the referendum might not be very problematic. The 2011 Census data were therefore seen as suitable to conduct this study. By comparing Local Authorities and including multiple factors within the same model, this study could conduct multivariable regression models and present (adjusted) statistical relevant associations between local characteristics and the EU referendum outcome. However, the referendum outcomes

for the Northern Ireland local districts are not included in the presented analyses. Since in Northern Ireland a minority voted 'Leave', including these local districts in the models could alter some of the results. Furthermore, given the ecological nature of the data (aggregated to Local Authorities), one can't infer associations for individual voters (e.g., Morgenstern 2008: 519–520).

As it is unclear what Brexit means, knowing more about differences in the EU referendum outcome between groups and local areas provides us with a better understanding of underlying factors of the Brexit-vote. This might be informative for the UK government in negotiating the Leave-conditions with the EU, and for the implementation of replacement regulations and policies. However, following Dorling (2016) about 13 million registered voters did not vote, and a further 7 million eligible adults were not registered. We don't know their preference, to remain in or to leave the EU, and their reasons for not voting. As it has been said these non-voters were disproportionately youngsters, renters, and members of ethnic minorities. They might have preferred to stay in the EU following the results of several post-referendum polls conducted in the summer suggesting that between 28% and 40% of non-voters believed it was wrong to leave the EU while 20% to 28% believed it was right.[23] To get a more complete picture of preferences on UK's relation with Europe it is worthwhile to investigate those non-voting groups. Although UK's history with the EU might differ from that of some other EU members, the findings from this study might also be of interest to the governments of other EU countries, especially EU members with a similar economic and socio-demographic composition as the UK.

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Appendix

Supplementary Table 1: Descriptive statistics of used Local Authority data in England (N=326).

Variables	Mean	Std. dev.	Min.	Max.
Outcome				
Proportion of Leave-votes England (N=326)	0.545	0.100	0.214	0.756
Predictors				
Pct. migrants arrived between 2004–2011 of population	4.6	4.6	0.5	25.0
Pct. national identity E/W/S/NI or British	93.7	6.5	64.4	99.3
Pct. main language is English and/or Welsh	93.7	7.0	58.6	99.3
Pct. unemployed	4.0	1.2	2.0	8.0
Pct. having a (semi-) routine, a lower supervisory or a lower technical occupation	32.2	7.2	13.9	51.7
Pct. highest educational qualification is level 2 or lower	51.4	7.8	23.7	66.0
Confounding factors				
Turnout rate	74.4	4.9	59.3	83.6
Pct. poor health within age group 16–64	14.7	2.9	8.9	23.2
Pct. poor health within age group 65+	49.7	6.4	36.2	68.0
Pct. male within age group 16–64	49.3	3.0	25.3	54.8
Pct. male within age group 65+	44.5	1.0	41.2	47.3
Pct. poorer health within males	17.3	3.1	10.8	25.9

Supplementary Table 2: Descriptive statistics of used non–London English Local Authority data (N=293).

Variables	Mean	Std. dev.	Min.	Max.
Outcome				
Proportion of Leave-votes England, excl. London (N=293)	0.562	0.080	0.262	0.756
Predictors				
Pct. migrants arrived between 2004–2011 of population	3.5	2.9	0.5	18.0
Pct. national identity E/W/S/NI or British	95.4	3.6	77.8	99.3
Pct. main language is English and/or Welsh	95.5	4.0	72.5	99.3
Pct. unemployed	3.9	1.2	2.0	8.0
Pct. having a (semi-) routine, a lower supervisory or a lower technical occupation	33.3	6.6	17.1	51.7
Pct. highest educational qualification is level 2 or lower	52.7	6.4	27.4	66.0
Confounding factors				
Turnout rate	74.9	4.6	59.8	83.6
Pct. poor health within age group 16–64	14.8	3.0	8.9	23.2
Pct. poor health within age group 65+	49.2	6.2	36.2	64.9
Pct. male within age group 16–64	49.3	3.2	25.3	54.8
Pct. male within age group 65+	44.6	1.0	41.3	47.3
Pct. poorer health within males	17.6	3.1	10.8	25.9

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[18] The question on main language was differently asked in the Scottish census. From that survey this study used the answer on the question 'Do you use a language other than English at home?'.

[19] Level 1 qualifications: 1-4 O Levels/CSE/GCSEs (any grades), Entry Level, Foundation Diploma, NVQ level 1, Foundation GNVQ, Basic/Essential Skills.
Level 2 qualification: 5+ O Level (Passes)/CSEs (Grade 1)/GCSEs (Grades A*-C), School Certificate, 1 A Level/ 2-3 AS Levels/VCEs, Intermediate/Higher Diploma, Welsh Baccalaureate Intermediate Diploma, NVQ level 2, Intermediate GNVQ, City and Guilds Craft, BTEC First/General Diploma, RSA Diploma Apprenticeship.
Level 3 qualifications: 2+ A Levels/VCEs, 4+ AS Levels, Higher School Certificate, Progression/Advanced Diploma, Welsh Baccalaureate Advanced Diploma, NVQ Level 3; Advanced GNVQ, City and Guilds Advanced Craft, ONC, OND, BTEC National, RSA Advanced Diploma.
Level 4+ qualifications: Degree (for example BA, BSc), Higher Degree (for example MA, PhD, PGCE), NVQ Level 4-5, HNC, HND, RSA Higher Diploma, BTEC Higher level, Foundation degree (NI), Professional qualifications (for example teaching, nursing, accountancy).

[20] Self-reported option were: very bad, bad, fair, good, or very good health. The percentage of poor health are based on those reporting very bad, bad, or fair general health condition.

[21] The 2016 EU Referendum Voting Guide.
https://www.aboutmyvote.co.uk/__data/assets/pdf_file/0010/203410/EU-Referendum-voting-guide_England-and-Scotland.pdf

[22] Transforming the results into proportion of leave-votes using the formula: 1/(1+EXP(-(constant + BX)), results into 1/(1+EXP(-(-2.415+(94*0.027))))=0.531.

[23] 'Brexit: Post-Referendum Hopes and Expectations', blog posted on 19 August 2016 by John Curtice. http://whatukthinks.org/eu/brexit-post-referendum-hopes-and-expectations/